

I Claim:

1. An imaging device comprising:
a semiconductor substrate;
plural light-responsive image elements defined in an array on said substrate;

5 and means for randomly accessing said image elements individually or in groups of less than the full plurality of elements on said array.

2. The imaging device of Claim 1 wherein said random image element accessing means includes a plurality of first and a plurality of second conductors traversing said array, each individual image element or group of image
5 elements being associated with a respective one of said plurality of first conductors and a respective one of said plurality of second conductors.

3. The imaging device of Claim 2 wherein said image elements each include means for photovoltaically producing an electrical charge in response to incident light, and storage means for storing said charge at said image
5 element.

4. The imaging device of Claim 3 wherein said image elements each also include means for draining stored charge from said charge storage means in response to an element resetting signal.

5. The imaging device of Claim 4 wherein said charge draining means includes a logic gate, and a conductor carrying an analogue voltage level.

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6. The imaging device of Claim 5 wherein said imaging element resetting signal is carried upon said respective one of said plurality of first or plurality of second conductors, and said resetting signal affects said

5 logic gate to switch said stored charge to said conductor carrying said analogue voltage level.

Sub B2
7. The imaging device of Claim 3 wherein each image element further includes an amplifier providing an output signal indicative of charge stored in said charge storage means.

8. The imaging device of Claim ³ wherein each image element further includes a switch connecting said amplifier to a conductor carrying said output signal externally of said array.

Sub B3
9. The imaging device of Claim 3 wherein said photovoltaic means includes a junction photodiode, said photodiode including a semiconductor substrate and a metallic film forming a metallic interface with said
5 substrate, said metallic film having electrical connection with said charge storage means, and said substrate having electrical connection with a source of analogue voltage allowing excess charge to spill from said photodiode into said substrate and to said source of analogue voltage,
10 whereby intense light incident upon said photodiode causes excess charge to spill into said substrate without significant effect of said excess charge upon said charge storage means of adjacent image elements in said array.

10. The imaging device of Claim 3 further including a pair of decoders and a pair of associated latches, each decoder and associated latch of said pair of associated decoders and latches respectively being associated with
5 one of said plurality of first conductors and with one of said plurality of second conductors, whereby said individual image elements or groups of image elements may be accessed by supplying a particular address to each of said pair of decoders.

11. The imaging device of Claim 10 further including a conductor traversing said array and receiving a signal indicative of stored charge on a particular charge storage device in response to access of a particular image element
 5 or group of image elements via said decoders, said device further including an image output buffer associated with said particular image element, said image output buffer receiving an enabling signal from one of said pairs of associated decoders and latches to conduct said stored-
 10 charge indicative signal externally of said array.

12. The imaging device of Claim 11 further including means for providing a coupling load for said signal indicative of stored charge on said particular image element, said means providing said
 5 coupling load providing an analogue image output signal.

13. The imaging device of Claim 12 wherein said means providing said coupling load further includes means for dynamic alteration of the coupling or gain between said signal indicative of stored charge and said analogue
 5 image output signal.

14. The imaging device of Claim 12 further including digitizing means for receiving said image output signal and providing a digital signal indicative of said image output signal.

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 15. The imaging device of Claim ~~10~~ further including a processor sequentially generating addresses of image elements or groups of image elements on said array to thereby define an imaging area or window on said array.

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~~16. The imaging device of Claim 3 further including second means for storing said charge at said image element, and switch means for selectively closing and opening connection between said first-recited charge~~

5 storage means and said ~~second~~ charge storage means.

17. The imaging device of Claim ~~16~~ further including means for simultaneously closing and opening said switch means of each of said plural image elements of said array, to thereby store on said second means for storing said charge of each of said plural image elements of said array a respective charge indicative of a "snap shot" of image.

18. The imaging device of Claim 1 further including a control cache memory for receiving control commands for said image elements at a high rate, for holding said control commands, and for providing said control commands to said image elements at a slower rate on a first-in, first-out basis.

19. An imaging device including an image element, said image element comprising a photovoltaic element for generating electrical charge in response to light incident upon said photovoltaic element, a charge storage device for receiving said generated charge, a logic gate and a first switch controlled by said logic gate for connecting said stored charge to a charge drain, an amplifier for producing an output signal indicative of said stored charge, a second switch for connecting said output signal to an output conductor, and a pair of image element reset and access conductors for controlling said logic gate and said second switch to alternatively drain charge from said charge storage device or conduct said output signal to said output conductor.

20. The imaging device of Claim 19 wherein said device includes a multitude of substantially similar image elements arranged in an array, each image element or group of such image elements including respective pairs of access conductors which in said array are associated with one another in accord with a geometry of said array, each

image element or group of such image elements being connected with a respective output conductor.

21. The imaging device of Claim 20 further including means for receiving a series of output signals from a series of said image elements in said array and for producing in response thereto a series of analogue signals
5 indicative of said output signals.

22. The imaging device of Claim 21 additionally including digitizing means for receiving said series of analogue signals and for producing a stream of digital signals indicative thereof.

23. The imaging device of Claim 20 wherein said array is of rectangular configuration with said image elements in aligned rows and columns, said access conductors being arranged in a rectangular grid.

24. The imaging device of Claim 23 further including a column access decoder for receiving a digital column address and producing a column select output in response thereto, a column select latch for receiving said column
5 select output and holding a latched column select output communicating with a particular one of the access conductors of said array, said device further including a digital row access decoder receiving a digital row address and producing a row select output in response thereto, a
10 row select latch for receiving said row select output and holding a latched row select output communicating with a particular one of the access conductors of said array.

25. The imaging device of Claim 19 further including another charge storage device, and a third switch interposed between said charge storage device and said another charge storage device.

26. The imaging device of Claim 25 wherein said another charge storage device is included in said amplifier.

27. The imaging device of Claim 22 further including
5 means for draining excess charge from said storage device, said draining means including a semiconductor substrate upon which said photovoltaic element is defined, and conductor means for establishing a reference analogue voltage level in said semiconductor substrate proximate to
10 said photovoltaic element.

28. The imaging device of Claim 22 further including an analogue output buffer providing a load to which said amplifier is coupled, and means for selectively varying the coupling of said amplifier to said load.

29. The imaging device of Claim 28 wherein said means for selectively varying the coupling of said amplifier with said load includes said output buffer defining a voltage follower circuit, and means for biasing
5 said voltage follower circuit.

30. The imaging device of Claim 19 wherein said device includes an array of plural image elements each substantially similar to said image element.

31. The imaging device of Claim 30 further including processor means for individually accessing a selected one of said plural image elements.

32. The imaging device of Claim 31 wherein said imaging device further includes an analogue-to-digital converter receiving an output signal from said output buffer and providing a digital signal indicative thereof.

33. The imaging device of Claim 24 further including a control cache memory for receiving at a first rate said digital columns address and said digital row address, for holding said addresses, and for providing said addresses
 5 at a second rate slower than said first rate and on a first-in, first-out basis to said column access decoder and row access decoder, respectively.

34. A method of providing an image of a scene, said method comprising the steps of:

providing an image element including a photovoltaic element which provides electric charge in response to
 5 light flux incident thereon,

storing electric charge from said photovoltaic element at said image element, and

connecting said stored charge to an output device only in response to an interrogation signal to said image
 10 element.

35. The method of Claim 34 further including the steps of providing an output amplifier at said image element as part of said output device.

Sub 36
 36. The method of Claim 35 wherein said step of providing said output amplifier includes providing a transistor at said image element, and using said stored charge to control an output voltage signal by controlling
 5 conductance of said transistor.

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 37. The method of Claim 36 further including the steps of providing a switch in series with said first-recited transistor, and turning said switch on to conduct said output voltage signal externally of said image
 5 element.

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 38. The method of Claim 37 further including the step of using another transistor as said switch.

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39. The method of Claim ¹⁶37 further including the steps of using a logic gate at said image element to receive said interrogation signal and control said switch.

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40. The method of Claim 34 ~~further including the steps of providing a switch connecting said stored charge to a reference voltage level, and closing said switch momentarily to reset said image element.~~

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41. The method of Claim ¹⁹40 including the further steps of allowing a predetermined integration time to pass after resetting of said image element, and subsequently to said integration time interrogating said image element by
5 providing said interrogation signal thereto in order to obtain time-integrated image information from said image element via said output device.

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42. The method of Claim 34 including the further steps of providing an array of plural image elements each substantially identical with said first-recited image element, and providing said interrogation signal only to
5 selected ones of said image elements in said array.

43. The method of Claim 34 including the further steps of providing an array of plural image elements each substantially identical with said first-recited image element, and simultaneously storing charge at each of
5 said plural image elements to provide a snap shot of said scene.

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44. The method of Claim ²²43 further including the steps of providing a switch at each of said plural image elements which resets said image element by draining stored charge therefrom when closed, and simultaneously
5 closing each of said charge-drainage switches at each of said image elements of said array to prepare said image array for said snap shot charge storage.

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45. The method of Claim 34 further including the step of using a processor to provide said interrogation signal to said image element.

Sub B10

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~~46~~. The method of Claim ²⁴~~45~~ further including the steps of using said processor to alter an output amplification level of said output device in preparation for connection of said stored charge thereto.

47. The method of Claim 34 further including defining said photovoltaic element on a semiconductor substrate, providing a conductor traversing said substrate proximate to said photovoltaic element, carrying a reference voltage level on said conductor, and using said conductor to collect excess charge spilling from said image element in response to an excessive level of light flux incident thereon, thereby to prevent said photovoltaic element from spilling excess charge across said substrate.

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~~48~~. The method of Claim ²⁴~~45~~ further including the step of providing a control cache in association with said processor, using said control cache to receive at a first rate control commands for said processor, using said control cache to hold said control commands, and feeding said control commands from said cache to said processor at a second slower rate on a first-in, first out basis.

49. An imaging device having an image element, said image element comprising:

a photoresponsive element providing electric charge in response to incident light flux,

a charge storage element receiving and storing electric charge from said photoresponsive element,

a gain control element interposed between said photoresponsive element and said storage element,

a charge drainage switch when closed connecting said

- 10 charge storage element to a charge drain therefor,
a logic gate controlling said charge drainage switch,
an output amplifier providing an output voltage level
indicative of charge stored on said charge storage
element, and
15 an output switch when closed connecting said output
voltage level to an output signal conductor.

50. The imaging device of Claim 49 wherein said
image element further includes another charge storage
element connecting with said first-recited charge storage
element to receive and store charge therefrom, and another
5 switch interposed between said first-recited charge
storage element and said another charge storage element to
when open isolate said another charge storage element from
said photoresponsive element.

51. The imaging device of Claim 49 further including
an array of plural imaging elements each of which is
substantially similar to said image element.

52. The imaging device of Claim 51 further including
means for randomly accessing each of said imaging elements
in said array.

53. The imaging device of Claim 52 wherein said
5 random accessing means includes a microprocessor
identifying each of said plural imaging elements
individually.